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APPLICANT(S): Masakazu Koyanagi, et al.

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INVENTION: CONTROLLER FOR PHOTOGRAPHING APPARATUS AND PHOTOGRAPHING SYSTEM

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

CERTIFIED TRANSLATION

Sir:

Yuka NAKAMURA residing at c/o SUGIURA PATENT OFFICE, 2nd floor, Metrocity Minami Ikebukuro, 29-12, Minami Ikebukuro 2-chome, Toshima-ku, Tokyo, JAPAN, declares:

(1) that she knows well both the Japanese and English languages;

(2) that she translated Japanese Application No. H09-261827 from Japanese to English;

(3) that the attached English translation is a true and correct translation of the above-identified Japanese Application to the best of her knowledge and belief; and

(4) that all statements made of her own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements are made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 USC 1001, and that such false statements may jeopardize the validity of the application or any patent issuing thereon.

November 30, 2007 Yuka Nakamura

Date Yuka NAKAMURA

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□Inventor□	
□Domicile or Residence□	c/o SONY CORPORATION 7-35, Kitashinagawa 6-chome, Shinagawa-ku, Tokyo, Japan
□Name□	Masakazu KOYANAGI
□Inventor□	
□Domicile or Residence□	c/o SONY CORPORATION 7-35, Kitashinagawa 6-chome, Shinagawa-ku, Tokyo, Japan
□Name□	Tadafusa TOMITAKA
□Inventor□	
□Domicile or Residence□	c/o SONY CORPORATION 7-35, Kitashinagawa 6-chome, Shinagawa-ku, Tokyo, Japan

□Name□	Toshiyuki IIJIMA
□Inventor□	
□Domicile or Residence□	c/o SONY CORPORATION 7-35, Kitashinagawa 6-chome, Shinagawa-ku, Tokyo, Japan
□Name□	Naoyasu HOSONUMA
□Inventor□	
□Domicile or Residence□	c/o SONY CORPORATION 7-35, Kitashinagawa 6-chome, Shinagawa-ku, Tokyo, Japan
□Name□	Ken TAMAYAMA
□Applicant□	
□ID Number□	000002185
□Name□	SONY CORPORATION
□Representative□	Nobuyuki IDEI
□Agent□	
□ID number□	100082762
□Patent Attorney□	
□Name□	Masatomo SUGIURA
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[Title of Document] Specification

[Title of the Invention] Controller for Photographing Apparatus and Photographing System

[Scope of Claims for a Patent]

[Claim 1]

A controller for a photographing apparatus for controlling the photographing direction of photographing means that is connected through a transmission path, comprising:

driving means for controlling the photographing direction of said photographing means;

picture selecting means for controlling said driving means and selecting a picture displayed by said photographing means;

a picture displaying area for driving said photographing means by said driving means and corresponding to the displayable range; and

means for superimposing a panorama picture on said picture displaying area.

[Claim 2]

A controller for a photographing apparatus for controlling the photographing direction of photographing means connected through a transmission path, comprising:

driving means for controlling the photographing direction of said photographing means; and

a picture selecting means for controlling said driving means and selecting a picture displayed by said

photographing means,

wherein said picture selecting means comprises an operation area for driving said photographing means by said driving means and corresponding to the displayable range,

wherein a panorama picture of said displayable range area superimposed and the user designates a desired point so as to move an object at the position corresponding to said desired point to a desired positional coordinates of said driving means in said operation area.

[Claim 3]

A controller for a photographing apparatus for controlling the photographing direction of photographing means that is connected through a transmission path, comprising:

driving means for controlling the photographing direction of said photographing means; and

picture selecting means for controlling said driving means and selecting a picture displayed by said photographing means,

wherein said picture selecting means comprises an operation area for driving said photographing means by said driving means and corresponding to the displayable range,

wherein a panorama picture in said displayable range is superimposed and the user designates a desired area so as to move an object at the position corresponding to a desired point generated from said desired area to the desired positional coordinates of said driving means in said operation

area.

[Claim 4]

A controller for a photographing apparatus as set forth in claim 1,

wherein a current position of said driving means is displayed on a panorama picture in said picture displaying area.

[Claim 5]

A controller for a photographing apparatus as set forth in claim 2 or 3,

wherein a current position of said driving means is displayed on a panorama picture of said picture selecting means.

[Claim 6]

A controller for a photographing apparatus as set forth in claim 1,

wherein the moving range of said driving means is displayed on a panorama picture of said picture displaying area.

[Claim 7]

A controller for a photographing apparatus as set forth in claim 2 or 3,

wherein the moving range of said driving means is displayed on a panorama picture of said picture selecting means.

[Claim 8]

A controller for a photographing apparatus as set

forth in claim 1,

wherein the angle of view of said photographing means is displayed on a panorama picture of said picture displaying area.

[Claim 9]

A controller for a photographing apparatus as set forth in claim 2 or 3,

wherein the angle of view of said photographing means is displayed on a panorama picture of said picture selecting means.

[Claim 10]

A controller for a photographing apparatus as set forth in claim 1, 2, or 3,

wherein an operation area to which a current picture displayed by said photographing means is put is included, and

wherein the user designates a desired point so as to move an object at the position corresponding to a desired point to a desired positional coordinates of said driving means in said operation area.

[Claim 11]

A controller for a photographing apparatus as set forth in claim 1, 2, or 3,

wherein said picture selecting means comprises an operation area to which a current picture displayed by said photographing means is put, and

wherein the user designates a desired area so as

to move an object at a position corresponding to a desired position generated from said desired area to a desired positional coordinates of said driving means in said operation area.

[Claim 12]

A photographing system for connecting photographing means and a controller for a photographing apparatus through a transmission path and controlling driving means for controlling the photographing direction of said photographing means by said controller for a photographing apparatus,

wherein said controller for a photographing apparatus comprises:

a picture selecting means for controlling said driving means and selecting a picture displayed by said photographing means;

a picture displaying area for driving said photographing means by said driving means and corresponding to the displayable range; and

means for superimposing a panorama picture on said picture displaying area.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention belongs]

The present invention relates to a controller for a photographing apparatus and a photographing system with a high operational characteristic and a high visibility

suitable for a photographing operation, using lines, of the apparatus that is disposed at a remote place and that is used for a monitoring operation, an observing operation, a guiding operation, a presenting operation, and so forth.

[0002]

[Prior Art]

As shown in Fig. 21, when the user controls a photographing apparatus disposed at a remote place, he or she operates a pan tilter in eight directions (up, down, left, right, upper right, lower right, upper left, and lower left directions) with eight-direction keys, a zooming controller, and a wide-angle controller so as to photograph a desired object while observing a photographed picture on a monitor 2. Alternatively, after the user has controlled a photographing apparatus disposed at a remote place in the above-describedmethodandregisteredpantilterinformation andzoominformationofpositionsofpicturestobephotographed, he or she drives the photographing apparatus at absolute positions corresponding to the registered positions so as to select pictures.

[0003]

[Subject that the Invention is to solve]

However, when picture and control information is exchangedwithaphotographingapparatusdisposedataremote placethroughalow-capacitynetwork, thecontrolinformation may be lost and/or picture information may be delayed due to an irregularity of their arrival intervals. If the pan

tilter or the zooming controller is operated in conventional method for picture and control information that has been delayed or lost, even if the user causes the pan tilter and the zooming controller to place the object at the desired position, the pan tilter and the zooming controller do not properly operate. Thus, the object is placed at an improper position due to the delay or line condition. Thus, the user should control the pan tilter and the zooming controller basedonaprediction. Consequently, theusercannotproperly control the pan tilter and the zooming controller.

[0004]

At this time, a pan tilter and a zooming controller arecontrolledthroughafeed-backoperationandanexperience. Therefore, when a picture loses its realtime, the amount of the feed-back becomes unstable.

[0005]

In addition, since the current picture is only a part that the photographing apparatus can move with the pan tilter, when the user detects the desired object from the moving range, all the moving range of the pan tilter is driven. In order to solve these subjects, it was desireble the controlling result is predicted beforehand and the condition of the photographing apparatus can be easily known.

[0006]

Therefore, an object of the present invention is to provide a picture selecting means, a controller for a photographingapparatusandphotographingsystemforallowing

theusertoeasilyobtainthedesiredpicturewithaphotograping apparatus that is operated according to the picture selecting means.

[0007]

Furthermore, an object of the present invention is to provide a controller for a photographing apparatus and photographing system for allowing the user to designate a desired position or a desired area on a panorama picture displayed as a part or all the moving range of a pan tilter so that the user can easily obtain a desired picture with the photographing apparatus.

[0008]

[Means for solving the subject]

The present invention described in claim 1 is a controller for a photographing apparatus for controlling the photographing direction of photographing means that is connected through a transmission path, comprising: driving means for controlling the photographing direction of said photographing means; picture selecting means for controlling said driving means and selecting a picture displayed by said photographing means; a picture displaying area for driving said photographing means by said driving means and corresponding to the displayable range; and means for superimposing a panorama picture on said picture displaying area.

[0009]

The present invention described in claim 12 is

a photographing system for connecting photographing means and a controller for a photographing apparatus through a transmission path and controlling driving means for controllingthephotographingdirectionofsaidphotographing meansbysaidcontrollerforaphotographingapparatus,wherein said controller for a photographing apparatus comprises: a picture selecting means for controlling said driving means andselectingapicturedisplayedbysaidphotographingmeans; a picture displaying area for driving said photographing meansbysaiddrivingmeansandcorrespondingtothedisplayable range; and means for superimposing a panorama picture on said picture displaying area.

[0010]

A picture photographed by a pan tilter camera that is disposed at a remote place and that can be moved in various directions through a ciucuit is sent to a computer. The picture is displayed as a panorama picture in a display area of a monitor. The direction of a picture selecting means corresponding to the direction of an object to be placed atthecenteroftheangleofviewofthephotographingapparatus in the panorama picture is designated by a pointing device connectedtothecomputer. Sincethepantilteriscontrolled with reference to the panorama picture, a desired picture can be photographed by the photographing apparatus.

[0011]

The present invention described in claim 2 is a controller for a photographing apparatus for controlling

thephotographingdirectionofphotographingmeansconnected through a transmission path, comprising: driving means for controllingthephotographingdirectionofsaidphotographing means; and a picture selecting means for controlling said driving means and selecting a picture displayed by said photographing means, wherein said picture selecting means comprises an operation area for driving said photographing meansbysaiddrivingmeansandcorrespondingtothedisplayable range, wherein a panorama picture of said displayable range area superimposed and the user designates a desired point so as to move an object at the position corresponding to said desired point to a desired positional coordinates of said driving means in said operation area.

[0012]

The present invention described in claim 3 is a controller for a photographing apparatus for controlling the photographing direction of photographing means that is connected through a transmission path, comprising: driving means for controlling the photographing direction of said photographing means; and picture selecting means for controlling said driving means and selecting a picture displayed by said photographing means, wherein said picture selecting means comprises an operation area for driving said photographing means by said driving means and corresponding to the displayable range, wherein a panorama picture in said displayable range is superimposed and the user designates a desired area so as to move an object at the position

corresponding to a desired point generated from said desired area to the desired positional coordinates of said driving means in said operation area.

[0013]

A picture photographed by a pan tilter camera that is disposed at a remote place and that can be moved in various derections through a circuit is sent to a computer. The picture is displayed in a display area of a monitor. In the case that a pan tilter camera has been set up the picture is displayed as a panorama picture in a panorama operation area. A desired point to be placed at the center of the angle of view of the photographing apparatus in a picture of the operation area or the panorama operation area or a desired point generated with a desired area is designated by the pointing device connected to the computer. Thus, in the method of which the result is input, a selected object can be easily placed at the center of the screen. In addition, since a desired point in the operation area on the screen or a desired point generated with a desired area is designated with the pointing device, the user can easily know the driving direction of the pan tilter camera.

[0014]

[Embodiment of the Invention]

Next, with reference to the accompanying drawings, embodiments of the present invention will be described. Fig. 1 shows an external view. A monitor 2 and a mouse 8 are connected to a computer 1. The computer 1 controls the driving

operation of a pan tiler camera 3 disposed at a remote place through a server 9 and a transmission path. In other words, a controller for the photographing apparatus is composed of the computer 1. As a transmission path, a communication line(wirelesscommunicationline,wiredcommunicationline), network and the like are usable. Since the computer 1 and the server 9 are in the cliant relation, a plurality of the computer 1s can be connected to the server 9.

[0015]

The pan tilter camera 3 is integrally composed of a pan tilter portion and a camera portion. In Fig. 1, the pan tilter camera 3 and the server 9 are disposed on arealsceneasdenotedby4. Ascreenofapicturephotographed by the pan tilter camera 3 is denoted by 5. This screen is hereinafter referred to as a photographed screen. The photographed screen 5 is an actually photographed screen. When a zoom lens of the pan tilter camera 3 is placed on the telephotograph side, the angle of view decreases. In contrast, when the zoom lens of the pan tilter camera 3 is placed on the wide-angle side, the angle of view increases.

[0016]

A picture on a photographed screen 5 captured by a pan tilter camera 3 is sent to a computer 1 through the server 9 and a transmission path. The picture sent to the computer 1 is displayed on a monitor 2. The monitor 2 displays the photographed screen 5 in an operation area 6A on the monitor 2. A panorama picture including the picture

photographed by the pan tilter camera 3 is displayed in a panorama operation area 6B. In this exmaple, an arrow-shaped cursor 7 is displayed at the position of a mouse pointer of a mouse 8 in the panorama display area 6B, and a frame 6C of which the mouse 8 is the center is displayed. A picture surrounded by the frame 6 of the panorama operation area 6B are displayed in the operation area 6A. As described later, the panorama operation area 6B comprises a pan tilter limiter 6D, and the pan tilter limiter 6D represents the limit of the moving range of the pan tilter camera 3.

[0017]

That is , as shown in Fig. 2, the operation area 6A and the panorama operation area 6B area displayed on the monitor 2. Though not shown, a picuture that is supplyed from the pan tilter camera 3 disposed at a remote place through the server 19 and the transmission path is displayed in the operation area 6A, and panorama pictures is displayed in the panorama operation area 6B. The panorama pictures are supplyed from the pan tilter camera 3, and then combined.

[0018]

Fig. 3 is a block diagram showing the overall system according to the embodiment of the present invention. The system shown in Fig. 3 comprises a camera portion 11, a pan tilter portion 12, a TV monitor 13, a server 9, a computer 1, a pointing device 14 (such as a mouse 8), and a monitor 2. The pan tilter camera 3 comprises a camera portion 11 and a pan tilter portion 12. For example, the camera portion

11 is disposed on the pan tilter portion 12. The camera portion 11 comprises a lens block portion 15, a zoom lens 16, a zoom portion 17, a zoom lens motor 18, a solid state image pickup device 19, a signal separating/automatic gain adjusting circuit (SH/AGC) 20, an A/D converter 21, and a signal processing circuit 22. The camera portion 11 represents a video camera.

[0019]

Thepantilterportion12comprisesamodecontroller 23, a camera controller 24, a pan tilter controller 25, a pan motor 26, a tilt motor 27, and a pan tilter 28. The computer 1 comprises a controlling portion 31, a video capture portion 29, and a storing portion 30. The video capture portion 29 is composed of a video capture board.

[0020]

Rays emitted from an object are focused to the solid state image pickup device 19 through a lens set and a diaphragm of the lens block portion 15. An example of the solid state image pickup device 19 is a CCD (Charge Coupled Device). The focused rays (field picture) are converted into a picture signal and then sent to the signal separating/automatic gain adjusting circuit 20. The signal separating/automaticgainadjustingcircuit20samples/holds the picture signal and controls the gain of the picture signal with a control signal of an auto iris (AE). The resultant picture signal is sent to the signal processing circuit 22 through the A/D converter 21. The signal processing circuit

22 converts the received picture signal into a brightness signal (Y), a color signal (C), and a video signal and sends these signals as picture signals to the video capture portion 29 of the computer 1 through the TV monitor 13 and the server 9.

[0021]

The lens block portion 15 of the camera portion 11 is a zoom lens that drives the zoom lens 16 and thereby varies the angle of view of an object to be photographed. The lens block portion 15 causes the zoom lens motor 18 that is for example a stepping motor to rotate, thereby driving the zoom lens 16 corresponding to a drive command received from the camera controller 24 of the pan tilter portion 12. The camera controller 24 performs a lens controlling operation (for example, focusing operation and zooming operation), an exposure controlling operation (for example, diaphragm controlling operation, gain controlling operation, and speed controlling operation of electronic shutter), white balance controlling operation, a picture quality controlling operation, and so forth of the camera portion 11. In addition, the camera controller 24 interfaces with the mode controller 23. As interface controlling operations with respect to the zoom lens 16, the camera controller 24 sends a control signal to the motor driver corresponding to a drive command of the zoom lens 16 received from the mode controller 23 so that the zoom lens 16 is placed at the position designated by the command. In addition, the camera controllers 24 always

sends positional information of the zoom lens 16 to the mode controller 23.

[0022]

The camera portion 11 is disposed on the pan tilter portion 12 that has a degree of freedom that are rotating directions of two axes of pan and tilt. The pan tilter portion 12 causes the pan motor 26 and the tilt motor 27 to rotate corresponding to a drive command received from the pan tilter controller 25, thereby driving a pan head and a tilt head of the pan tilter 28. The motors 26 and 27 are composed of for example stepping motors. The pan tilter controller 25 sends a control signal to the motor drivers so that the pan head and the tilt head are driven to positions corresponding to a pan drive command and a tilt drive command received from mode controller 23. In addition, the pan tilter controller 25 always sends positional information of the pan head and the tilt head to the mode controller 23.

[0023]

The mode controller 23 controls the overall system corresponding to the internal states of the camera portion 11 and the pan tilter portion 12 and the interface information received from the outside of the pan tilter camera 3 as will be described later. The mode controller 23 is connected with for example the computer 1 and RS-232C interface. The mode controller 23 sends drive commands received from the computer 1 to the pan tilter controller 25 and the camera controller 24 so as to drive the pan tilter 28 and the zoom

lens 16 of the lens block portion 15. In addition, the mode controller 23 sends current positional information received from the pan tilter controller 25 and the camera controller 24 to the computer 1.

[0024]

According to the embodiment, the computer 1 is used to select a picture photographed by the pan tilter camera 3. The computer 1 processes graphics in the operation area 6A and the panorama operation area 6B displayed on the monitor 2 and information of a designated position and a clicking operation of the pointing device 14 (mouse 8) and sends the resultant data to the mode controller 23. To display a picture photographed by a camera portion 11 on the monitor 2, a video capturing portion 29 is used. The video capturing portion 29 allows a video signal received from the camera portion 11 to be displayed on the monitor 2 with a desired picture quality. In addition, the video capturing portion 29 allows a picture to be captured in a particular picture format (for example, bit map format, still picture JPEG format, moving picture JPEG format, or the like) with a particular picture quality and to be stored in the storing portion 30 (for example, a hard disk) of the computer 1.

[0025]

Next, with reference to Fig. 4, an example of a method for generating a panorama picture will be described. Now, it is assumed that the environment in the place where the pan tilter camera 3 is disposed is a spherical surface.

The spherical surface is referred to as virtual spherical surface. In Fig. 4, two adjacent pictures on the virtual spherical surface are combined to one panorama picture. To generate a panorama picture, as shown in Fig. 4A, the pan tilter camera 3 disposed at the center of the sphere photographs two adjacent pictures on the virtual spherical surface. The pan tilter camera 3 photographs a plane perpendicular to the optical axis of the lens thereof. Fig. 4D shows a situation of which two adjacent pictures on the virtual spherical surface are photographed by the pan tilter camera 3 and the two pictures are mapped to the plane perpendicular to the optical axis. When two adjacent pictures are simply combined, they overlap and distort at the overlapped portion.

[0026]

To prevent two adjacent pictures from overlapping and distorting, they are mapped to the virtual spherical surface as shown in Fig. 4B. Fig. 4E shows a situation of which two photographed pictures that are planes perpendicular to the optical axis are mapped to the virtual spherical surface. In such a manner, planes perpendicular to the optical axis (namely, photographed pictures) are mapped to the virtual spherical surface. The mapped pictures are combined in such a manner that an overlapped portion and an unnecessary portion are removed. The picture mapped on the virtual spherical surface is normalized with longitude and latitude. Thus, a panorama picture as shown in Figs. 4C and 4D is generated.

[0027]

Next, a method for generating a panorama picture will be described. In this method, as shown in Fig. 5, one panoramapictureisgeneratedbycombining10pictures. First, the pan tilter camera 3 (not shown) disposed at the center of the sphere photographs 10 pictures. At this point, as shown in Fig. 5A, by matching the optical axis of the lens of the pan tilter camera 3 to positions denoted by circles, the pan tilter camera 3 can obtain pictures 1 to 10. As shown in Fig. 5B, the pictures photographed by the pan tilter camera3arepicturesontheplaneperpendiculartotheoptical axis of the lens. The obtained pictures are mapped to the virtual spherical surface. Thereafter, as shown in Fig. 5C, the pictures are normalized with latitude and longitude. The pictures are obtained in such a manner that they are smoothlycombinedwithoutabreak. Thereafter, anoverlapped portionandunnecessaryportionareremoved. Thus, apanorama pictureofwhich10picturearesmoothlycombinedisgenerated.

[0028]

Next, with reference to Fig. 6, another method for generating a panorama picture will be described. In this method, pixels obtained by the pan tilter camera 3 are designated to pixels of a panorama picture normalized with latitude and longitude (namely, coordinates (s, t)). As in the method shown in Fig. 5, when pixels of pictures photographed by the pan tilter camera 3 are designated to pixels of a panorama picture, part of pixels of the panorama picture may not be designated. All pixels of pictures

photographed by the pan tilter camera 3 should be designated to pixels of the panorama picture. The panorama picture is composed of pixels calculated for individual coordinate points in the following process. Angular coordinates (α, β) (seeFig. 6B) onthevirtualsphericalsurfacecorresponding to coordinates (s, t) (see Fig. 6) of a panorama picture are calculated corresponding to Eq. (1).

[0029]

$$(\alpha, \beta) = (a(s), b(t)) \quad \ldots (1)$$

(Eq. (1) will be described later with reference to Fig. 7.)

[0030]

As shown in Fig. 6C, coordinate data (ξ, η) of the obtained picture is calculated with the coordinates (s, t), the angular coordinates (θ, φ) of a pan tilter 28, and photographing magnification assuming that the wide edge of the photographing apparatus is defined as one magnification corresponding to Eq. (2).

[0031]

$$(\xi, \eta) = (f(\alpha, \beta, \theta, \varphi, \gamma), g(\alpha, \beta, \theta, \varphi, \gamma)) \quad \ldots (2)$$

(Eq. (2) will be described later with reference to Fig. 8.)

[0032]

Corresponding to the above-described equations, pixels of the panorama picture are correlated with obtained pictures so as to generate a combined picture (namely, the panorama picture).

[0033]

Next, with reference to Fig. 7, a method for converting coordinates (s, t) of a panorama picture into angular coordinates (α, β) on the virtual spherical surface will be described. In Fig. 7A, PragMin represents angular data at the left edge assuming that the home position of the pan tilter 28 is 0 (rag). PragMax represents angular data at the right edge assuming that the home position of the pan tilter 28 is 0 (reg). Ny_2 represents a horizontal coordinate of the panorama operation area 6B. $-Ny_2 / 2$ represents coordinate data at the right edge of the panorama operation area 6B.

[0034]

To obtain the pan angle α with the coordinate data s, since the following relation is satisfied

$$(\text{PragMax} - \alpha) : (\text{PragMax} - \text{PragMin}) = (Ny_2 / 2 - s) : Ny_2$$

the pan angle α is expressed as follows.

$$\alpha = \text{PragMax} - (\text{PragMax} - \text{PragMin}) \times (Ny_2 / 2 - s) / Ny_2$$

[0035]

In Fig. 7B, TragMin represents angular data at the upper edge assuming that the home position of the pan tilter 28 is 0 (rag). TragMax represents angular data at the lower edge assuming that the home position of the pan tilter 28 is 0 (rag). Nz_2 represents a vertical coordinate of the panorama operation area 6B. $-Nz_2 / 2$ represents coordinate data at the upper edge of the panorama operation

arae 6B. Nz_2 / 2 represents coordinate data at the lower edge of the panorama operation area 6B.

[0036]

To obtain the tilt angle β with the coordinate data t, since the following relation is satisfied,

$(TragMax - \beta) : (TragMax - TragMin) = (Nz_2 / 2 - t) : Nz_2$

the tilt angle β is expressed as follows.

$\beta = TragMax - (TragMax - TragMin) \times (Nz_2 / 2 - t) / Nz_2$

[0037]

Next, with reference to Fig. 8, the method for convertingaplaneintoasphericalsurfacewillbedescribed. As shown in Fig. 8A, the spatial coordinates of a point (ξ, η) of a photographed picture orienting the home position (theoriginoflatitudeandlongitude)areexpressedasfollows.

[0038]

[Equation 1]

$$\begin{aligned} \boldsymbol{P} &= \boldsymbol{e}_x + k_1 \xi \boldsymbol{e}_\xi + k_2 \eta \boldsymbol{e}_\eta \\ &= \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} + k_1 \xi \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} + k_2 \eta \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \\ &= \begin{bmatrix} 1 \\ -k_1 \xi \\ k_2 \eta \end{bmatrix} \end{aligned}$$

[0039]

At this point, the following relations are satisfied.

k_1 = tan (λ / 2γ) / (Ny / 2)

k_2 = tan (μ / 2γ) / (Nz / 2)

where (Ny, Nz) represent the drive ranges (y direction and z direction) of the mouse pointer of the pointing device 14 (mouse 8); (λ, μ) represents the horizontal angle of view and vertical angle of view at the wide edge; and γ represents the current zoom relative magnification (magnification information) assuming that the wide edge is one time (× 1).

[0040]

Inaddition,asshowninFig.8B,athree-dimensional rotation matrix is generally expressed as follows.

[0041]

[Equation 2]

$$R_y(\phi) = \begin{bmatrix} \cos\phi & 0 & -\sin\phi \\ 0 & 1 & 0 \\ \sin\phi & 0 & \cos\phi \end{bmatrix}$$

$$R_z(\theta) = \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

[0042]

Since the direction of one point (ξ, η) of a photographed picture that is panned and tilted by angular information (θ, φ) from the home position is the same as the direction of one point (α, β) apart from the home position,

the following relation is satisfied.

[0043]

$R_z(\theta)\ R_Y(\varphi)\ p = 1R_z(\alpha)\ R_Y(\beta)\ e_x$

When the formula is solved with respect to p, the following relation is satisfied.

[0044]

[Equation 3]

$$p = l\, R_y(-\phi)\, R_z(\alpha - \theta)\, R_y(\beta)\, e_x$$
$$= l \begin{bmatrix} \cos(\alpha - \theta)\cos\phi\cos\beta + \sin\phi\sin\beta \\ \sin(\alpha - \theta)\cos\beta \\ -\cos(\alpha - \theta)\sin\phi\cos\beta + \cos\phi\sin\beta \end{bmatrix}$$

[0045]

Thereon,

[0046]

[Equation 4]

$$p = l \begin{bmatrix} a \\ b \\ c \end{bmatrix} \qquad (3)$$

[0047]

Thus, ξ and η are obtained as follows.

[0048]

$1 = 1 / a$

$\xi = -1b / k_1 = -b / k_{1a}$

$\eta = 1c / k_2 = c / k_{2a}$

With the above formula, (ξ, η) projected to the photograph coordinates can be obtained with coordinate data with an angle (α, β) from the home position.

[0049]

$\xi = (-\sin(\alpha - \theta) \cos\beta) / (k_1 (\cos(\alpha - \theta) \cos\varphi \cos\beta + \sin\varphi \sin\beta))$

$\eta = (-\cos(\alpha - \theta) \sin\varphi \cos\beta + \cos\varphi \sin\beta) / (k_2 (\cos(\alpha - \theta) \cos\varphi \cos\beta + \sin\varphi \sin\beta))$

Coordinate data (ξ, η) on the obtained picture by the pan tilter camera 3 can be obtained from angular coordinates (α, β) on the virtual spherical surface corresponding to coordinate (s, t) of a panorama picture. Thus, a panorame picture can be generated.

[0050]

In contrast, coordinate data with an angle (α, β) can be obtained with (ξ, η) projected to photograph coordinates corresponding to the following formula.

[0051]

Since $1 = |p|$

$a = 1 / \sqrt{(1 + k_1^2\xi^2 + k_2^2\eta^2)}$

$b = -k_1\xi / \sqrt{(1 + k_1^2\xi^2 + k_2^2\eta^2)}$

$c = k_2 \eta / \sqrt{(1 + k_1^2\xi^2 + k_2^2\eta^2)}$

where $\sqrt{(\ )}$ represents that the square root of the calculated result in ( ) is obtained.

[0052]

Form Formula (3), the following relations are

satisfied.

$$a = \cos(\alpha-\theta)\ \cos\varphi\ \cos\beta + \sin\varphi\ \sin\beta$$

$$b = \sin\ (\alpha-\theta)\ \cos\beta$$

$$c = -\cos\ (\alpha-\theta)\ \sin\varphi\ \cos\beta + \cos\varphi\ \sin\beta$$

[0053]

Thus, the following relations are satisfied.

$$a \sin\varphi + c \sin\theta = \sin\beta$$

$$\tan\ (\alpha-\theta) = b\ /\ (a \cos\varphi - c \sin\theta)$$

Thus, the following relations are satisfied.

$$\beta = \sin^{-1}\ (\sin\varphi\ /\ \sqrt{}\ (1 + k_1^2\ \xi^2 + k_2^2\ \eta^2) + \sin\theta\ k_2\ \eta\ /\ \sqrt{}(1 + k_1^2\ \xi^2 + k_2^2\ \eta^2)$$

$$\alpha = \tan^{-1}\ (-k_1\ \xi\ /\ (\cos\varphi - k_2\ \eta\ \sin\theta)) + \theta$$

[0054]

Thus, the pan angle α and the tilt angle β can be obtained as follows.

$$(\alpha, \beta) = (f(\xi, \eta, \theta, \varphi, \gamma),\ g(\xi, \eta, \theta, \varphi, \gamma)) \quad \ldots(4)$$

[0055]

If an error is permitted to some extent, (α, β) can be expressed as follows.

[0056]

$$\alpha = \theta + (\lambda/\gamma) \times (\xi\ /\ Ny)$$

$$\beta = \varphi + (\mu/\gamma) \times (\eta\ /\ Nz)$$

In other words, Eq. (4) can be simplified as follows.

$$(\alpha, \beta) = (f(\xi, \theta, \gamma),\ g(\eta, \varphi, \gamma)) \quad \ldots\ (5)$$

[0057]

Next, with reference to Fig. 9, a method for

calculating angular information (α, β) of the pan tilter 28 expressed by Eq. (4) and Eq. (5) with positional coordinates (ξ, η) of the operation area 6A will be described. First of all, an example of a method for directly designating a desired point in the operation area 6A will be described. Assuming that the center of the operation area 6A is defined as (0, 0) of relative coordinates as shown in Fig. 9A, the positional coordinates (ξ, η) of the mouse pointer of the mouse 8 in the operation area 6A are obtained.

[0058]

Next, another method for designating a desired point generated with a desired area in the operation area 6A will be described. As shown in Fig. 9A, after a start point (m1, n1) in a desired area is designated, an end point (m2, n2) in the desired area is designated. As the coordinates at the center of the rectangle generated with these two points, a desired point (ξ, η) is obtained as Eq. (6).

$$(\xi, \eta) = ((m1, n1) + (m2, n2)) / 2 \quad \ldots (6)$$

[0059]

Fig. 9A shows coordinates of the mouse 8 (pointing device 14) in the operation area 6A. In Fig. 9A, the moving range (y direction and z direction) of the mouse pointer of the mouse 8 in the operation area 6A is denoted by (Ny_1, Nz_1). Angular coordinates (α, β) of the pan tilter 28 are obtained with positional coordinates (ξ, η) of the desired point (at the mouse pointer of the mouse 8), angular information (θ, φ) that represents the orientation of the pan tilter 28,

andmagnificationinformation (γ) of the current zoom relative magnification assuming that the wide edge of the zoom lens 16 is defined as one magnification corresponding to Eq. (4) or Eq. (5).

[0060]

The angular coordinates (α, β) shown in Fig. 9B are used to place a position designated by the pointing device to the center of the photographed screen assuming that the home position of the pan tilter 28 is defined as the origin of latitude and longitude.

[0061]

The coordinates obtained in Fig. 9 may be absolute coordinates of the screen of the monitor 2 or relative coordinates assuming that the center of the operation area 6A is defined as (0, 0). In the coordinates shown in Fig. 9, coordinates in the pan direction are represented by ξ, m1, m2, θ, and α and coordinates in the tilt direction are represented by η, n1, n2, φ, and β.

[0062]

Thus, when the mouse pointer of the mouse 8 is present in the operation area 6A, the angular information (α, β) of the pan tilter 28 is calculated with the angular information (θ, φ) of the current pan tilter 28 obtained with received data, the zoom magnification information (γ), and the positional information (ξ, η) at the mouse pointer of the mouse 8 corresponding to Eq. (4) or Eq. (5) so that the designated object is placed at the center of the operation

area 6A. The angular coordinates (α, β) of the pan tilter 28 are converted into internal positional information (p-new, t-new) as shown in Fig. 11. The resultant internal positional information (p-new, t-new) is stored in a send buffer along with an absolute position drive command of the pan tilter 28. In addition, as will be described later, a data send request flag (Flag-so) is set so that data is sent upon occurrence of a timer event.

[0063]

Next, with reference to Fig. 10, a method for converting positional coordinates (ξ, η) of the mouse pointer of the mouse 8 in the panorama operation area 6B of the panorama picture into angular coordinates (α, β) corresponding to the present invention will be described. As with the method for directly designating a desired point in the operation area 6A, as shown in Fig. 10A, with a method for directly designating a desired point in the panorama operation area 6B, positional coordinates (ξ, η) at the mouse pointer of the mouse 8 can be obtained.

[0064]

Next, another method for designating a desired point generated with a desired area in the panorama operation area 6B will be described. As shown in Fig. 10A, after a start point (m1, n1) of a desired area is designated, the end point (m2, n2) of the desired area are designated. Corresponding to Eq. (6), a desired point (ξ, η) is obtained.

[0065]

In Fig. 10A, the moving range (y direction and z direction) of the mouse pointer of the mouse 8 in the panorama operation area 6B (the moving range is defined as the coordinates of the mouse pointer of the mouse 8 (pointing device 14) in the panorama operation area 6B) is represented by (Ny_2, Nz_2). The moving range is limited by the pan tilter limiter 6D denoted by dotted lines in the panorama operation area 6B. The pan tilter limiter 6D represents the moving range of the optical axis of the lens of the pan tilter camera 3. In other words, a point cannot be designated out of the pan tilter limiter 6D. Positional coordinates (x, y) in the panorama operation area 6B, angle-of-view information (s, t), and angular information (α, β) of the pan tilter 28 can be obtained with the positional coordinates (ξ, η) of the desired point, the angular information (θ, φ) representing the orientation of the pan tilter 28, and the magnification information (γ) as the current zoom relative magnification assuming that the wide edge of the zoom lens 16 is defined as one magnification corresponding to Eq. (7), Eq. (8), and Eq. (9).

[0066]

$$(x,\ y) = (f_0(\theta),\ g_0(\varphi)) \quad \ldots (7)$$

$$(s,\ t) = (f_1(\gamma),\ g_1(\gamma)) \quad \ldots (8)$$

$$(\alpha, \beta) = (f(\xi),\ g(\eta)) \quad \ldots (9)$$

In Fig. 10B, positional coordinates (x, y) represent the current orientation of the pan tilter 28 assuming that the home position of the pan tilter 28 is defined as the

originoflatitudeandlongitude. Angle-of-viewinformation (s, t) is the current angle of view in the operation area 6A. Fig. 10B represents the states of the zoom lens and the pan tilter in the panorama operation area 6B.

[0067]

In Fig. 10C, angular coordinates (α, β) are used to place the position designated by the pointing device to the center of the photographed screen assuming that the home position of the pan tilter 28 is defined as the origin of latitude and longitude. (PragMax, TragMax) and (PragMin, TragMin) represent the moving range of the pan tilter (namely, the range represented by the pan tilter limiter 6D). Fig. 10C shows a drive target value in the pan tilter moving range.

[0068]

InFig.10,coordinatestobeobtainedmaybeabsolute coordinates on the screen of the monitor 2 or relative coordinatesassumingthatthecenterofthepanoramaoperation area 6B is defined as (0, 0). In the coordinates, coordinates in the pan direction are represented by ξ, m1, m2, x, s, and α and coordinates in the tilt direction are represented by η, n1, n2, y, t, and β.

[0069]

Thus, when the mouse pointer of the mouse 8 is present in the panorama operation area 6B, angular information (α, β) of the pan tilter 28 is calculated with positional information (ξ, η) at the mouse pointer of the mouse 8 corresponding to Eq. (9) so that the designated object in

the operation area 6A is placed at the center of the operation area 6A. Angular coordinates (α, β) of the pan tilter 28 are convertedintointernalpositionalinformation(p-new,t-new) of the pan tilter 28 corresponding to the method shown in Figs.11Aand11B. Theinternalpositionalinformation(p-new, t-new) of the pan tilter 28 is stored in a send buffer along with an absolute position drive command of the pan tilter 28. In addition, as will be described later, a data send requestflag(Flag-so)issetsothatdataissentuponoccurrence of the timer event.

[0070]

Next, a method for converting internal positional information(p,t)ofthepantilter28intoangularinformation (θ, φ) and a method for converting angular coordinates (α, β) into internal positional information (p-new, t-new) of the pan tilter 28 will be described with reference to Fig. 11. In Fig. 11A, PragMin represents angular data at the left edge assuming that the home position of the pan tilter 28 is 0 (rag). PragMax represents angular data at the right edge assuming that the home position of the pan tilter 28 is 0 (rag). PdatMin represents internal count data at the left edge of the pan tilter controller 25. PdatMax represents internal counter data at the right edge of the pan tilter controller 25.

[0071]

To obtain the pan angle θ with the pan data p, since the following relation is satisfied,

$(PragMax - \theta) : (PragMax - PragMin) = (PdatMax - p) : (PdatMax - PdatMin)$

the pan angle θ is expressed as follows.

$\theta = PragMax - (PragMax - PragMin) \times (PdatMax - p) / (PdatMax - PdatMin)$

[0072]

Thus, the pan data p is expressed as follows.

$p = PdatMax - (PragMax - \theta) \times (PdatMax - PdatMin) / (PragMax - PragMin)$

[0073]

In addition, to obtain the pan data p-new with the pan angle α, since the following relation is satisfied,

$(PragMax - \alpha) : (PragMax - PragMin) = (PdatMax - p\text{-}new) : (PdatMax - PdatMin)$

the pan data p-new is expressed as follows.

$P\text{-}new = PragMax - (PragMax - \alpha) \times (PdatMax - PdatMin) / (PragMax - PragMin)$

[0074]

In Fig. 11B, TragMin represents angular data at the upper edge assuming that the home position of the pan tilter 28 is 0 (rag). TragMax represents angular data at the lower edge assuming that the home position of the pan tiler 28 is 0 (rag). TdatMin represents internal count data at the upper edge of the pan tilter controller 25. TdatMax represents internal count data at the lower edge of the pan tilter controller 25.

[0075]

To obtain the tilt angle φ with the tilt data t, since the following relation is satisfied,

(TragMax - φ) : (TragMax - TragMin) = (TratMax - t) : (TdatMax - TdatMin)

the tilt angle φ is expressed as follows.

φ = TragMax - (TragMax - TragMin) × (TdatMax - t) / (TdatMax - TdatMin)

[0076]

Thus, the tilt data t is expressed as follows.

t = TdatMax - (TragMax - φ) × (TdatMax - TdatMin) / (TragMax - TragMin)

[0077]

To obtain the tilt data t-new with the tilt angle β, since the following relation is satisfied,

(TragMax - β) : (TragMax - TragMin) = (TdatMax - t-new): (TdatMax - TdatMin)

the tilt data TNew is expressed as follows.

T-new=TragMax- (TragMax-β) × (TdatMax-TdatMin) / (TragMax - TragMin)

[0078]

Next, with reference to Fig. 12, a method for converting positional coordinates (ξ, η) in the panorama operation area 6B into angular coordinates (α, β) of the pan tilter 28 and a method for converting angular information (θ, φ) of the pan tilter 28 into positional coordinates (x, y) in the panorama operation area 6B will be described. In Fig. 12A, PragMin represents angular data at the left edge

assuming that the home position of the pan tilter 28 is 0 (rag). PragMax represents angular data at the right edge assuming that the home position of the pan tilter 28 is 0 (rag). Ny_2 represents a horizontal coordinate of the panorama operation area 6B. $-Ny_2 / 2$ represents coordinate data at the left edge of the panorama operation area 6B. $Ny_2 / 2$ represents coordinate data at the right edge of the panorama operation area 6B.

[0079]

To obtain the pan angle α with the coordinate data ξ, since the following relation is satisfied,

$$(\text{PragMax} - \alpha) : (\text{PragMax} - \text{PragMin}) = (Ny_2 / 2 - \xi) : Ny_2$$

the pan angle α is expressed as follows.

$$\alpha = \text{PragMax} - (\text{PragMax} - \text{PragMin}) \times (Ny_2 / 2 - \xi) / Ny_2$$

[0080]

To obtain the coordinate data x with the pan angle θ, since the following relation is satisfied,

$$(\text{PragMax} - \theta) : (\text{PragMax} - \text{PragMin}) = (Ny_2 / 2 - x) : Ny_2$$

the coordinate data x is expressed as follows.

$$x = Ny_2 / 2 - (\text{PragMax} - \theta) \times Ny_2 / (\text{PragMax} - \text{PragMin})$$

[0081]

In Fig. 12B, TragMin represents angular data at the upper edge assuming that the home position of the pan tilter 28 is 0 (rag). TragMax represents angular data at

the lower edge assuming that the home position of the pan tilter 28 is 0 (rag). Nz_2 represents a vertical coordinate of the panorama operation area 6B. $-Nz_2 / 2$ represents coordinate data at the upper edge of the panorama operation area 6B. $Nz_2 / 2$ represents coordinate data at the lower edge of the panorama operation area 6B.

[0082]

To obtain the tilt angle β with the coordinate data η, since the following relation is satisfied,

$(TragMax - \beta) : (TragMax - TragMin) = (Nz_2 / 2 - \eta) : Nz_2$

the tilt angle β is expressed as follows.

$\beta = TragMax - (TragMax - TragMin) \times (Nz_2 / 2 - \eta) / Nz_2$

[0083]

To obtain the coordinate data y with the tilt angle φ, since the following relation is satisfied,

$(TragMax - \varphi) : (TragMax - TragMin) = (Nz_2 / 2 - y) : Nz_2$

the coordinate data y is expressed as follows.

$y = Nz_2 / 2 - (TragMax - \theta) \times Nz_2 / (TragMax - TragMin)$

[0084]

Next, with reference to Fig. 13, a method for converting angle-of-view information (ψ, ω) captured by the pan tilter 28 into angle-of-view information (s, t) of the frame 6C in the panorama operation area 6B will be described. Fig. 13A shows the current angle-of-view information (ψ,

ω) of the pan tilter 28. The angle-of-view information (ψ, ω) is expressed as follows.

$$(\psi, \omega) = 1 / \gamma \times (\psi 0, \omega 0)$$

At this point, (ψ0, ω0) represent the horizontal angle of viewandtheverticalangleofviewatthewideedge. γrepresents the magnification of the lens assuming that the wide edge is defined as one magnification.

[0085]

As shown in Fig. 13B, PragMin represents angular data at the left edge assuming that the home position of the pan tilter 28 is 0 (rag). PragMax represents angular data at the right edge assuming that the home position of the pan tilter 28 is 0 (rag). Ny_2 represents a horizontal coordinate of the panorama operation area 6B. $-Ny_2 / 2$ represents coordinate data at the left edge of the panorama operation area 6B. $Ny_2 / 2$ represents coordinate data at the right edge of the panorama operation area 6B.

[0086]

To obtain the horizontal angle of view s with the horizontal angle of view ψ, since the following relation is satisfied,

$$\psi : (\mathrm{PragMax} - \mathrm{PragMin}) = s : Ny_2$$

horizontal angle of view s is expressed as follows.

$$s = \psi \times Ny_2 / (\mathrm{PragMax} - \mathrm{PragMin})$$

[0087]

In Fig. 13C, TragMin represents angular data at the lower edge assuming that the home position of the pan

tilter 28 is 0 (rag). TragMax represents angular data at the upper edge assuming that the home position of the pan tilter 28 is 0 (rag). Nz_2 represents a vertical coordinate of the panorama operation area 6B. $-Nz_2 / 2$ represents coordinate data at the lower edge of the panorama operation area 6B. $Nz_2 / 2$ represents coordinate data at the upper edge of the panorama operation area 6B.

[0088]

To obtain the vertical angle of view t with the vertical angle of view ω, since the following relation is satisfied,

$$\omega : (TragMax - TragMin) = t : Nz_2$$

the vertical angle of view t is expressed as follows.

$$t = \omega \times Nz_2 / (TragMax - TragMin)$$

[0089]

Thus, the angle-of-view information (s, t) shown in Fig. 13D is displayed as the frame 6C in the panorama operation area 6B.

[0090]

Next, with reference to Fig. 14, a method for converting the positional information (z) of the zoom lens 16 into magnification information (γ) will be described. In Fig. 14, the vertical axis represents information of lens magnification, whereas the horizontal axis represents the internal information of zoom lens. The positional information (z) of the zoom lens 16 is converted into the magnification information (γ) by the computer 1 corresponding

to a conversion graph shown in Fig. 14. For example, the positionalinformation(z)isconvertedintothemagnification information (γ) corresponding to a ROM table or an equation.

[0091]

Next, with reference to Fig. 15, an example of a control algorithm of the computer 1 will be described. When the program is executed, the flow advances to step S1. At step S1, the operation area 6, the panorama operation area 6B, the cursor 7, and the pan tilter limiter 6D are initialized and displayed on the monitor 2 as shown in Fig. 2. The range of the pan tilter limiter 6D may be fixed or variable. At step S2, a timer is set so that the computer 1 communicates with the mode controller 23 at predetermined intervals. After such initial setup operations have been completed, the flow advances to step S3. At step S3, the system waits for an occurrence of an event. Corresponding to an event that occurs, the flow advances to a relevant step (for example, a timer event (at step S4), a mouse button down event (at step S5), a mouse button up event (at step S6), and a mouse move event (at step S7)).

[0092]

Next, with reference to a flow chart shown in Fig. 16, the algorithm of the timer event will be described. The timereventisaneventforcausingthecomputer1tocommunicate with the mode controller 23 at predetermined intervals. The timer event occurs at intervals of for example 50 msec. When the timer event occurs, the flow advances to step S11. At

step S11, the system determines whether or not a communication port has been set. When the communication port has been set (namely, the determined result at step S11 is Yes), the flow advances to step S12. When the communication port has not been set (namely, the determined result at step S11 is No), the flow advances to step S18. At the first time the communication port has not been set, the flow advances to step S18. At step S18, the system opens the communication port. Actually, at step S18, the system opens an RS-232C port of the computer 1. Thereafter, the flow advances to step S16.

[0093]

Thereafter, in the timer event, the system performs a receive data checking process, an analyzing process, a data sending process for data stored in the send buffer (such as the drive command for the pan tilter 28), and/or a communication data sending process for state check requests for the pan tilter 28 and the zoom lens 16. In this algorithm, the flow advances from step S11 to step S12. At step S12, the system determines whether or not data is stored in the receive buffer. When data is stored in the receive buffer (namely, the determined result at step S12 is Yes), the flow advances to step S13. When data is not stored in the receive buffer (namely, the determined result at step S12 is No), the flow advances to step S14. At step S13, the system analyzes receive data stored in the receive buffer and obtains positional information (p, t) of the pan tilter 28 and positional

information (z) of the zoom lens 16 that have been requested to the mode controller 23. The system converts the positional information (p, t) of the pan tilter 28 and the positional information (z) of the zoom lens 16 into angular information (θ, φ) of the pan tilter 28 and magnification information (γ) of the zoom lens 16 corresponding to methods shown in Fig. 11 and 14.

[0094]

At step S14, the system determines whether or not a data send request has been issued. When a data send request has been issued (Flag-so == True) (namely, the determined result at step S14 is Yes), the flow advances to step S19. At step S19, the system sends data stored in the send buffer and resets the send request flag (Flag-so == False). Next, the flow advances to step S16. An example of data stored in the send buffer is data of a drive command of the pan tilter 28 designated with the mouse 8. When a send request has not been issued (Flag-so == False) (namely, the determined result at step S14 is No), the flow advances to step S15. At step S15, the system sends position request commands for the pan tilter 28 and the zoom lens 16 from the computer 1 to the mode controller 23.

[0095]

At step S16, the system compares the old positional information of the pan tiler 28 with the new positional information thereof and determines whether or not the positional information (p, t) has varied. When the positional

information (p, t) of the pan tilter 28 has varied (namely, the determined result at step S16 is Yes), the flow advances to step S20. When the positional information (p, t) of the pan tilter 28 has not varied (namely, the determined result at step S16 is No), the flow advances to step S17. At step S17, the system compares the old positional information of the zoom lens 16 with the new positional information thereof and determines whether or not the positional information (z) has varied. When the positional information (z) of the zoom lens 16 has varied (namely, the determined result at step S17 is Yes), the flow advances to step S20. When the positional information (z) of the zoom lens 16 has not varied (namely, the determined result at step S17 is No), this event is completed.

[0096]

At step S20, when the positional information (p, t) of the pan tilter 28 and/or the positional information (z) of the zoom lens 16 has varied, the system redraws the frame 6C in the panorama operation area 6B. At this point, the system converts the positional information (p, t) of the pan tilter 28 into the angular information (θ, φ). In addition, the system converts the positional information (z) of the zoom lens 16 into the magnification information (γ). With the converted angular information (θ, φ) and magnification information (γ), the system calculates positional coordinates (x, y) of the pan tilter 28 and angle-of-view information (s, t) that is the angle of view

displayed in the operation area 6A corresponding to Eq. (7) and Eq. (8), respectively. Corresponding to the resultant positional coordinates (x, y) and angle-of-view information (s, t), the system draws the frame 6C in the panorama operation area 6B.

[0097]

At step S16, the system compares the old positional information (p, t) of the pan tilter 28 with the new positional information (p, t) thereof. Alternatively, the system may compare the old angular information (θ, φ) of the pan tilter 28 with the new angular information (θ, φ) thereof. In this case, at step S20, with the new angular information (θ, φ), the system calculates the positional coordinates (x, y) corresponding to Eq. (7). Likewise, at step S17, the system compares the old positional information (z) of the zoom lens 16 with the new positional information (z) thereof. Alternatively, the system may compare the old magnification information (γ) of the zoom lens 16 with the new magnification information (γ) thereof. In this case, at step S20, the system calculates the angular information (s, t) with the new magnification information (γ) corresponding to Eq. (8).

[0098]

Next, with reference to a flow chart shown in Fig. 17, the algorithm of the mouse move event will be described. The mouse move event is an event that occurs when the mouse 8 is moved. According to the present invention, the mouse move event is used to select a drive position of the pan

tilter 28. When the mouse move event occurs, the flow advances to step S21. At step S21, the system determines whether or not the mouse pointer of the mouse 8 is present in the operation area 6A, the panorama operation area 6B, or the other area shown in Fig. 2. When the mouse pointer of the mouse 8 is present in the operation area 6A (namely, the determined result at step S21 is Yes), the flow advances to step S22. When the mouse pointer of the mouse 8 is not present in the operation area 6A (namely, the determined result at step S21 is No), the flow advances to step S24. At step S22, the system sets an operation area flag (Flag-rin == True) and clears a panorama operation area flag (Flag-pin == False).

[0099]

At step S24, since the mouse pointer of the mouse 8 is not present in the operation area 6A, the system clears the operation area flag (Flag-rin == False). At step S25, the system determines whether or not the mouse pointer of the mouse 8 is present in the panorama operation area 6B. When the mouse pointer of the mouse 8 is present in the panorama operation area 6B (namely, the determined result at step S25 is Yes), the flow advances to step S26. When the mouse pointer of the mouse 8 is not present in the panorama operation area 6B (namely, the determined result at step S25 is No), the flow advances to step S27. At step S26, the system sets the panorama operation area flag (Flag-pin == True). At step S27, since the mouse pointer of the mouse 8 is not present

inthepanoramaoperationarea6B, thesystemclearthepanorama operation area flag (Flag-pin == False).

[0100]

When the mouse pointer of the mouse 8 is present in the operation area 6A or the panorama operation area 6B (namely, the determined result at step S21 or step S25 is Yes), at step S23, the system obtains positional coordinates (ξ, η) of the mouse pointer of the mouse 8 assuming that the center of the operation area is defined as (0, 0) of relative coordinates.

[0101]

In this flow chart, when the mouse pointer of the mouse 8 is present in the operation area 6A (namely, the determined result at step S22 is Yes), the system sets the operationareaflag(Flag-rin==True). Whenthemousepointer of the mouse 8 is not present in the operation area 6A (namely, the determined result at step S22 is No), the system clears the operation area flag (Flag-rin == False). When the mouse pointer of the mouse 8 is present in the panorama operation area 6B (namely, the determined result at step S25 is Yes), the system sets the panorama operation area flag (Flag-pin == True). When the mouse pointer 8 is not present in the panorama operation area 6A (namely, the determined result at step S25 is No), the system clears the panorama operation area flag (Flag-pin == False). When the mouse pointer of the mouse 8 is present in the operation area 6A or the panorama operation area 6B (namely, the determined result at step

S21 or S35 is Yes), the system designates the positional coordinates of the mouse pointer of the mouse 8 to (ξ, η) assuming that the center of each operation area is defined as (0, 0) of relative coordinates.

[0102]

Next, the mouse button down event and the button up event will be described. In the method for directly designating a desired point of the operation area 6A or the panorama operation area 6B, only the algorithm of a mouse button down event shown in Fig. 18 is used. In the method for designating a desired point generated with a desired area, both the algorithm of a mouse button down event shown in Fig. 19 and the algorithm of a mouse button up event shown in Fig. 20 are used.

[0103]

With reference to a flow chart shown in Fig. 18, the algorithm of the button down event for the method for directly designating a desired point of the operation area will be described. This event is an event that occurs when the left button of the mouse 8 is pressed. In the present invention, this event is used as trigger information for driving the pan tilter 28. When this event occurs, the flow advances to step S31. At step S31, the system determines whether or not the mouse pointer 8 is present in the operation area 6A corresponding to the operation area flag. When the operation area flag has been set (Flag-rin == True) (namely, the determined result at step S31 is Yes), since the mouse

pointer of the mouse 8 is present in the operation area 6A, the flow advances to step S32. When the operation area flag has been cleared (Flag-rin == False) (namely, the determined result at step S31 is No), since the mouse pointer of the mouse 8 is not present in the operation area 6A, the flow advances to step S34.

[0104]

When the mouse pointer of the mouse 8 is present in the operation area 6A (namely, the determined result at step S31 is Yes), the flow advances to step S32. At step S32, the system calculates angular information (α, β) of the pan tilter 28 with the angular information (θ, φ) of the current pan tilter 28 obtained from the received data, the magnification information (γ) of the zoom lens 16, and the positional coordinate (ξ, η) of the mouse pointer of the mouse 8 in the operation area 6A corresponding to Eq. (4) or Eq. (5) so that the designated object in the operation area is placed at the center of the screen.

[0105]

At step S33, the system converts the angular information (α, β) of the pan tilter 28 into the internal positional information (p-new, t-new) corresponding to the method shown in Fig. 11. The system stores the converted positional information (PNew, TNew) in the send buffer along with the absolute position drive command of the pan tilter 28. In addition, the system sets the data send request flag (FlagSo == True) and sends the data with the process of the

timer event.

[0106]

After the system has determined that the mouse pointer of the mouse 8 is not present in the operation area 6A (namely, the determined result at step S31 is No), the flow advances to step S34. At step S34, the system determines whether or not the mouse pointer of the mouse 8 is present in the panorama operation area 6B corresponding to the panorama operation area flag. When the panorama operation flag has been set (Flag-pin == True) (namely, the determined result at step S34 is Yes), since the mouse pointer of the mouse 8 of the panorama operation area 6B is present in the panorama operation area 6B, the flow advances to step S35. When the panorama operation flag has been cleared (Flag-pin == Fale) (namely, the determined result at step S34 is No), this event is completed.

[0107]

In this flow chart, the system determines whether or not the mouse pointer of the mouse 8 is present in the operation area 6A or the panorama operation area 6B corresponding to the operation area flag (Flag-rin) and the panorama operation area flag (Flag-pin). When the mouse pointer of the mouse 8 is not present in the operation area 6A and the panorama operation area 6B, this event becomes invalid.

[0108]

When the mouse pointer of the mouse 8 is present

in the panorama operation area 6B (namely, the determined result at step S34 is Yes), the flow advances to step S35. At step S35, the system calculates angular information (α, β) of the pan tilter 28 with the positional information (ξ, η) at the mouse pointer of the mouse 8 in the panorama operation area 6B corresponding to Eq. (9) so that the designated object in the operation area is placed at the center of the screen. Thereafter, the flow advances to step S33.

[0109]

Next, with reference to Figs. 19 and 20, the algorithms of the button down event and the button up event for the method for designating a desired point generated with a desired area in the panorama operation area 6B will be described, respectively.

[0110]

With reference to the flow chart shown in Fig. 19, the algorithm of the button down event will be described. This event is an event that occurs when the left button of the mouse 8 is pressed. In this embodiment, this event is used as an event for determining the start point of a desired area. When this event occurs, the flow advances to step S41. At step S41, the system determines whether or not the mouse pointer of the mouse 8 is present in the operation area 6A corresponding to the operation area flag (Flag-rin). When the operation area flag has been set (Flag-rin == True) (namely, the determined result at step S41 is Yes), since the mouse pointer of the mouse 8 is present in the operation

area 6A, the flow advances to step S42. When the operation area flag has been cleared (Flag-rin == False) (namely, the determined result at step S41 is No), since the mouse pointer of the mouse 8 is not present in the operation area 6A, the flow advances to step S44.

[0111]

When the mouse pointer of the mouse 8 is present in the operation area 6A (namely, the determined result at step S41 is Yes), at step S42, the system sets an operation areastartpointobtainflag(Flag-rstart=True). Thereafter, the flow advances to step S43. At step S43, the system stores positional coordinates (m1, n1) at which the left button of the mouse 8 is pressed as the start point of the desired area.

[0112]

After the system has determined that the mouse pointer of the mouse 8 is not present in the operation area 6A, at step S44, the system determines whether or not the mousepointerofthemouse8ispresentinthepanoramaoperation area 6B corresponding to the panorama operation area flag (Flag-pin). When the panorama operation area flag has been set (Flag-pin == True) (namely, the determined result at step S44 is Yes), since the mouse pointer of the mouse 8 ispresentinthepanoramaoperationarea6B, theflowadvances to step S45. When the panorama operation area flag has been cleared (Flag-pin == False) (namely, the determined result at step S44 is No), this event is completed.

[0113]

In this flow chart, the system determines whether or not the mouse pointer of the mouse 8 is present in the operation area 6A or the panorama operation area 6B corresponding to the operation area flag (Flag-rin) and the panorama operation area flag (Flag-pin). When the mouse pointer of the mouse 8 is not in the operation area 6A and the panorama operation area 6B, this event becomes invalid.

[0114]

When the mouse pointer of the mouse 8 is present in the panorama operation area 6B (namely, the determined result at step 44 is Yes), the flow advances to step S45. At step S45, the system sets a panorama operation area start point obtain flag (Flag-pstart). Thereafter, the flow advances to step S43.

[0115]

Next, with reference to a flow chart shown in Fig. 20, the algorithm of the button up event will be described. This event is an event that occurs when the left button of the mouse 8 is released. In the present invention, the button up event is used as an event for determining the end point of a desired area.

[0116]

When this event occurs, the flow advances to step S51. At step S51, the system determines whether or not the operation area flag has been set (Flag-rin == True) (namely, the mouse pointer of the mouse 8 is present in the operation

area 6A). When the operation area flag has been set (Flag-rin = True) (namely, the determined result at step S51 is Yes), since the mouse pointer of the mouse 8 is present in the operation area 6A, the flow advances to step S52. When the operation area flag has been cleared (Flag-rin == False) (namely, the determined result at step S51 is No), since the mouse pointer of the mouse 8 is not present in the operation area 6A, the flow advances to step S57. At step S52, the system determines whether or not the left button of the mouse 8 has been pressed in the operation area 6A corresponding to an operation area start point obtain flag (Flag-rstart). When the start point obtain flag has been set (Flag-rstart == True) (namely, the determined result at step S52 is Yes), since the left button of the mouse 8 has been pressed in the operation area 6A, the flow advances to step S53. When the start point obtain flag has been cleared (Flag-rstart == False) (namely, the determined result at step S52 is No), since the left button of the mouse 8 has not been pressed in the operation area 6A, the flow advances to step S57.

[0117]

In other words, at steps S51 and S52, the system determines whether or not the operation area flag and the operation area start point obtain flag have been set or cleared. When the operation area flag and the start point obtain flag have been set (Flag-rin == True and Flag-rstart == True), the system determines that the drive command has taken place in the operation area 6A. Otherwise, at steps S57 and S58,

the system determines whether or not the panorama operation area flag (Flag-pin) and the panorama operation area start point obtain flag (Flag-pstart) have been set or cleared.

[0118]

When the drive command has taken place in the operation area (namely, the operation area flag and the start pointobtainflaghavebeenset(Flag-rin==TrueandFlag-rstart == True), at step S53, the system stores the positional coordinates (m2, n2) at which the left button of the mouse 8 has been released in the operation area 6A as the end point of the desired area. Thereafter, the system calculates positional information (ξ, η) as the coordinates of the center oftherectangleareageneratedwiththepositionalcoordinates (m1,n1)ofthestartpointofthedesiredareaandthepositional coordinates (m2, n2) of the end point thereof.

[0119]

At step S54, the system calculates angular information (α, β) of the pan tilter 28 with the angular information (θ, φ) of thepantilterobtainedfromthereceived data, the magnification information (γ) of the zoom lens 16, and the positional information (ξ, η) at the mouse pointer of the mouse 8 corresponding to Eq. (4) or Eq. (5).

[0120]

At step S55, the system converts the angular information (α, β) of the pan tilter 28 into the internal positional information (p-new, t-new) of the pan tiler 28 corresponding to the method shown in Fig. 11 and stores the

positional information (p-new, t-new) to the send buffer along with the absolute position drive command. In addition, the system sets the data send request flag (Flag-so == True) and sends data with the process of the timer event.

[0121]

At step S56, after the system has checked the mouse button up event in each operation area, the system clears the operation area start point obtain flag and the panorama operation area start point obtain flag (Flag-rstart == False and Flag-pstart == False). Thereafter, this event is completed.

[0122]

At step S57, the system determines whether or not the mouse pointer of the mouse 8 is present in the panorama operation area 6B corresponding to the panorama operation area flag (Flag-pin). When the panorama operation area flag has been set (Flag-pin == True) (namely, the determined result at step S57 is Yes), since the mouse pointer of the mouse 8 is present in the panorama operation area 6B, the flow advances to step S58. When the panorama operation area flag has not been set (Flag-pin == False), since the mouse pointer of the mouse 8 is not present in the panorama operation area 6B, the flow advances to step S56. At step S58, the system determines whether or not the left button of the mouse 8 has been pressed in the panorama operation area 6B corresponding to the panorama operation area start point obtain flag (Flag-pstart). When the start point obtain flag has been

set (Flag-pstart == True) (namely, the determined result at step S58 is Yes), since the left button of the mouse 8 has been pressed in the panorama operation area 6B, the flow advances to step S59. When the start point obtain flag has not been set (Flag-pstart == False) (namely, the determined result at step S58 is No), since the left button of the mouse 8 has not been pressed in the panorama operation area 6B, the flow advances to step S56.

[0123]

When the panorama operation area flag and the panorama operation start point obtain flag have been set (FlagPin == True and FlagPstart == True) at steps S57 and S58, the system determines that a drive command has issued in the panorama operation area 6B. When the conditions at steps S51, S52, and S58 are not satisfied, this event becomes invalid.

[0124]

Whenthedrivecommandhasbeenissuedinthepanorama operation area 6B (namely, the panorama operation area flag and the start obtain flag have been set (Flag-pin == True and Flag-pstart == True), the flow advances to step S59. At step S59, the system stores the positional coordinates (m2, n2) at which the left button of the mouse 8 has been released in the panorama operation area 6B as the end point of the desired area. The system calculates the positional information (ξ, η) of the mouse pointer of the mouse 8 as the coordinates of the center of the rectangle area with

the positional coordinates (m1, n1) of the start point of the desired area that has been stored and the positional coordinates (m2, n2) of the end point of the desired area corresponding to Eq. (6).

[0125]

At step S60, the system calculates angular information (α, β) of the pan tilter 28 with the positional information (ξ, η) at the mouse pointer of the mouse 8 in the panorama operation area 6B corresponding to Eq. (9) so that the designated object in the panorama operation area is placed at the center of the screen. Thereafter, the flow advances to step S55.

[0126]

In the first embodiment, whenever the pan tilter camera 3 sends a picture to the computer 1, the computer 1 combines it and displays the combined picture in the panorama operation area 6B. Alternatively, after the computer has combined all pictures, it may display the resultant picture in the panorama operation area 6B.

[0127]

According to the first embodiment, the computer 1 forms a panorama picture. Alternatively, the server 9 may form a panorama picture and send the data of the panorama picture to the computer 1 through a low capacity network line, and display the picture in the panorama operation area 6B of the monitor 2.

[0128]

According to the first embodiment, the operation area 6A and the panorama operation area 6B are displayed on the monitor 2 connected to the computer 1. Alternatively, the operation area 6A and/or the panorama operation area 6B may be displayed on another display unit other than the monitor 2.

[0129]

According to the first embodiment, the pan tilter camera 3 is driven by operating the operation area 6A and thepanoramaoperationarea6Bwiththemouse8. Alternatively, one of the operation area 6A and the panorama operation area 6B may be operated with the mouse 8.

[0130]

According to the first embodiment, the operation area 6A and the panorama operation area 6B are displayed onthemonitor2. Alternatively, onlythepanorama operation area 6B may be displayed on the monitor 2.

[0131]

According to the first embodiment, the operation area 6A and the panorama operation area 6B are displayed on the monitor 2. By operating the operation area 6A and the panorama operation area 6B with the mouse 8, the pan tilter camera 3 is freely driven. Alternatively, a panorama picture may be displayed on the monitor 2. In this case, the pan tilter camera 3 maybe driven with an operationportion such as eight-direction keys.

[0132]

Accordingtothesecondembodiment, forsimplicity, one computer 1 is connected to the remote server 9 and the pan tilter camera 3 that are disposed at a remote place. Alternatively, a plurality of servers 9 and a plurality of pan tilter cameras 3 may be disposed worldwide. For example, one pan tilter camera 3 may be controlled by a plurality of computers through Internet, for example.

[0133]

Accordingtotheabove-describedembodiments, the photographing range of the pan tilter camera 3 may be the maximum moving range of the pan tilter camera 3 or limited with a limiter. The function for limited the photographing range with the limiter may be provided by the pan tilter camera 3 or the computer 1.

[0134]

Inthefirstembodiments, adesiredpointgenerated with a desired area is placed at the center of thereof. Alternatively, a desired point may be placed at for example the center of gravity, the incenter, the circumcenter, or the orthocenter of the area.

[0135]

According to the first embodiment, a panorama picture displayed in the panorama operation area 6B is not limited as long as it represents the environment in which thepantiltercamera3isdisposed. Forexample, thepanorama picturemaybeamovingpicture, anintermittentstillpicture, or a still picture.

[0136]

[Effects of the Inveniton]

According to the present invention, a desired object can be displayed at the center of the operation area with the clicking operation of the mouse. In addition, since the position to which the pan tilter moves can be predicted beforehand, on a communication line that causes picture and information data to be delayed and/or lost (such as Internet), the user can seamlessly operate the pan tilter camera. Thus, according to the present invention, the pan tilter camera can be easily operated with high visibility.

[0137]

According to the present invention, with a panorama picture, the user can see the environment in which the photographing apparatus is disposed at a glance. Since the positional information of the pan tilter, the angle of view of the zoom lens, and the moving range of the pan tilter are added as information to the picture, the user can easily know the state of the photographing apparatus. In addition, when the user designates a desired object in the panorama operation area, he or she can easily capture it in the field of view of the picture to be photographed. Moreover, by designating an object in the operation area, the user can precisely adjust the position that cannot be designated in the panorama operation area.

[Brief Description of the Drawings]

[Fig. 1]

An external view for explaining a system according to the present invention.

[Fig. 2]

A schematic diagram for explaining a screen according to the present invention.

[Fig. 3]

A block diagram showing the structure of the system according to the embodiment of the present invention.

[Fig. 4]

A schematic diagram for explaining a method for generating a panorama picture according to the present invention.

[Fig. 5]

A schematic diagram for explaining a method for generating a panorama picture according to the present invention.

[Fig. 6]

A schematic diagram for explaining a method for generating a panorama picture according to the present invention.

[Fig. 7]

A schematic diagram for explaining a method for generating angular information of a pan tilter camera with positional coordinates in a panorama operation area according to the present invention.

[Fig. 8]

A schematic diagram for explaining a plane -

spherical surface converting method according to the present invention.

[Fig. 9]

A schematic diagram for explaining a coordinate converting method in the operation area according to the present invention.

[Fig. 10]

A schematic diagram for explaining a coordinate converting method in the panorama operation area according to the present invention.

[Fig. 11]

A schematic diagram for explaining positional information and angular information of a pan tilter camera according to the present invention.

[Fig. 12]

A schematic diagram for explaining angular coordinatesofthepantiltercameraandpositionalcoordinates in the panorama operation area according to the present invention.

[Fig. 13]

A schematic diagram for explaining the angle of view of the pan tilter camera and a frame in the panorama operation area according to the present invention.

[Fig. 14]

A graph for explaining a conversion method of zoom dataandmagnificationdataaccordingtothepresentinvention.

[Fig. 15]

A flow chart showing an example of the overall process according to the present invention.

[Fig. 16]

A flow chart showing an example of the process of a timer event according to the present invention.

[Fig. 17]

A flow chart showing an example of the process of a mouse moving event according to the present invention.

[Fig. 18]

A flow chart showing an example of the process of a mouse button down event according to the present invention.

[Fig. 19]

A flow chart showing another example of the process of a mouse button down event according to the present invention.

[Fig. 20]

A flow chart showing an example of the process of a mouse up/down event according to the present invention.

[Fig. 21]

A system through the conventional transmission path.

[Description of Reference Numerals]

1 ... Computer, 2 ... Monitor, 6A ... Operation area, 6B ... Panorama operation area, 7 ... Cursor, 9 ... Server, 11 ... Camera portion, 12 ... Pan tilter portion, 13 ... TV monitor, 14 ... Pointing device, 15 ... Lens block, 16 ... Zoom lens, 17 ... Zoom portion, 18, 26, 27 ... Motor, 19 ... Solid state image pickup device, 20 ... Signal separating/automatic

gain adjusting circuit, 21 ... A/D converter, 22 ... Signal processing, 23 ... Mode controller, 24 ... Camera controller, 25 ... Pan tilter controller, 28 ... Pan tilter, 29 ... Video capture, 30 ... Storing portion, 31 ... Controlling portion

[Title of Document] Abstract

[Abstract]

[Subject]

To easily obtain a desired picture by displaying a part or whole of the moving range of a pan tilter camera that is connected through a transmission path as a panorama picture and designating a desired position or a desired area on the panorama picture.

[Solving Means]

A picture photographed by a camera portion 11 is sent to a video capturing portion 29 of a computer 1. The picture is displayed in an operation area 6A of a monitor 2. A panorama picture of which pictures in part or all moving range of a pan tilter 28 are combined is displayed in a panorama operation area 6B. A pan tilter portion 12 sends positional information of pan and tilt to the computer 1 through a mode controller 23. With a mouse 8, the operation area 6A and 6B are operated so as to the computer 1 obtain data for driving the pan tilter 28. Thus, the selected object is displayed at the center of the operation area.

[Selected Drawing] Fig. 3

Translation of Drawings

FIG. 1

3 ... PAN TILTER CAMERA

9 ... SERVER

FIG. 2

6A ... OPERATION AREA

6B ... PANORAMA OPERATION AREA

FIG. 3

(A) ... VIDEO SIGNAL

(B) ... DRIVE COMMAND

(C) ... POSITIONAL INFORMATION

(D) ... CONTROL, POSITIONAL INFORMATION

(E) ... ZOOM

15 ... LENS BLOCK

22 ... SIGNAL PROCESSING

11 ... CAMERA PORTION

13 ... TV MONITOR

28 ... PAN TILTER

26 ... PAN MOTOR

27 ... TILT MOTOR

24 ... CAMERA CONTROLLER

25 ... PAN TILTER CONTROLLER

23 ... MODE CONTROLLER

2 ... MONITOR

6A ... OPERATION AREA

6B ... PANORAMA OPERATION AREA

9 ... SERVER

31 ... CONTROLLING PORTION

29 ... VIDEO CAPTURE

30 .. STORING PORTION

1 ... COMPUTER

14 ... POINTING DEVICE

FIG. 6

(1) ... PICTURE CONVERTED INTO SPHERICAL SURFACE IS NORMALIZED WITH LATITUDE AND LONGITUDE

(2) ... CAPTURED PICTURE

(3) ... OBTAINED PICTURE

FIG. 7

(1) ... PAN ANGLE

(2) ... COORDINATE DATA

(3) ... TILT ANGLE

(4) ... COORDINATE DATA

FIG. 11A

(1) ... PAN ANGLE

(2) ... PAN DATA

FIG. 11B

(1) ... TILT ANGLE

(2) ... TILT DATA

FIG. 12A

(1) ... PAN ANGLE

(2) ... COORDINATE DATA

FIG. 12B

(1) ... TILT ANGLE

(2) ... COORDINATE DATA

FIG. 13A

(1) ... HORIZONTAL ANGLE OF VIEW (ψ)

(2) ... VERTICAL ANGLE OF VIEW (ω)

FIG. 13B

(1) ... PAN ANGLE

(2) ... COORDINATE DATA

FIG. 13C

(1) ... PAN ANGLE

(2) ... COORDINATE DATA

FIG. 13D

(1) ... HORIZONTAL ANGLE OF VIEW (s)

(2) ... VERTICAL ANGLE OF VIEW (t)

FIG. 14

(1) ... INFORMATION OF LENS MAGNIFICATION

(2) ... INTERNAL INFORMATION OF ZOOM LENS

FIG. 15

(A) ... START

S1 ... INITIALIZE OPERATION AREA ON MONITOR.

S2 ... SET TIMER EVENT.

S3 ... DETERMINE TYPE OF EVENT THAT OCCURS.

S4 ... TIMER EVENT

S5 ... MOUSE BUTTON DOWN EVENT

S6 ... MOUSE BUTTON UP EVENT

S7 ... MOUSE MOVE EVENT

FIG. 16

(A) ... START

(B) ... NO

(C) ... YES

(D) ... NO

(E) ... YES

(E)' ... YES (TRUE)

(E)" ... NO (FALSE)

(F) ... YES

(G) ... NO

(H) ... YES

(I) ... NO

(J) ... END

S11 ... HAS COMMUNICATION PORT BEEN SET ?

S12 ... IS DATA STORED IN RECEIVE BUFFER ?

S13 ... ANALYZE RECEIVE DATA, OBTAIN PAN TILTER POSITION (p, t) AND ZOOM POSITION (z), AND CALCULATE PAN TILTER ANGLE (θ, φ) AND ZOOM MAGNIFICATION (γ).

S14 ... IS SEND REQUEST FLAG Flag-So TRUE ?

S15 ... SEND PAN TILER, ZOOM POSITION REQUEST COMMUNICATION DATA.

S18 ... SET COMMUNICATION PORT.

S19 ... SEND DATA STORED IN SEND BUFFER AND RESET Flag-So TO FALSE.

S16 ... HAS PAN TILTER DATA VARIED ?

S17 ... HAS ZOOM DATA VARIED ?

S20 ... REDRAW FRAME IN PANORAMA PICTURE AREA.

FIG. 17

(A) ... START

(B) ... NO

(C) ... YES

(D) ... NO

(E) ... YES

(F) ... END

S21 ... IS MOUSE POINTER PRESENT IN OPERATION AREA ?

S23 ... OBTAIN COORDINATES (ξ, η) OF POSITION OF MOUSE POINTER IN OPERATION AREA.

S25 ... IS MOUSE POINTER PRESENT IN PANORAMA OPERATION AREA ?

FIG. 18

(A) ... START

(B) ... NO (FALSE)

(C) ... YES (TRUE)

(D) ... NO (FALSE)

(E) ... YES (TRUE)

(F) ... END

S32 ... OBTAIN (α, β) WITH EACH DATA.

S33 ... CONVERT (α, β) INTO PAN TILTER POSITIONAL COORDINATES (P-New, T-New), STORE THEM AS ABSOLUTE POSITION DRIVE REQUEST COMMUNICATION DATA TO COMMUNICATION BUFFER, AND SET Flag-So TO TRUE.

S35 ... OBTAIN (α, β) WITH EACH DATA.

FIG. 19

(A) ... START

(B) ... NO (FALSE)

(C) ... YES (TRUE)

(D) ... NO (FALSE)

(E) ... YES (TRUE)

(F) ... END

S42 ... SET START POINT OBTAIN FLAG Flag-Rstart TO TRUE.

S43 ... OBTAIN COORDINATES (m1, n1) AT THE POINT.

S45 ... SET START POINT OBTAIN FLAG Flag-Pstart TO TRUE.

FIG. 20

(A) ... START

(B) ... NO (FALSE)

(C) ... YES (TRUE)

(D) ... NO (FALSE)

(E) ... YES (TRUE)

(F) ... NO (FALSE)

(G) ... YES (TRUE)

(H) ... NO (FALSE)

(I) ... YES (TRUE)

(J) ... END

S53 ... OBTAIN COORDINATES (m2, n2) AND THEREBY (ξ, η) AT THIS POINT.

S54 ... OBTAIN (α, β) WITH EACH DATA.

S55 ... CONVERT (α, β) INTO PAN TILTER POSITIONAL COORDINATES (P-New, T-New), STORE THEM AS ABSOLUTE POSITION DRIVE REQUEST COMMUNICATION DATA TO COMMUNICATION BUFFER, AND SET Flag-So TO TRUE.

S56 ... SET START POINT OBTAIN FLAG Flag-RStart TO FALSE AND Flag-Pstart TO FALSE.

S59 ... OBTAIN COORDINATES (m2, n2) AND THEREBY (ξ, η) AT THIS POINT.

S60 ... OBTAIN (α, β) WITH EACH DATA.

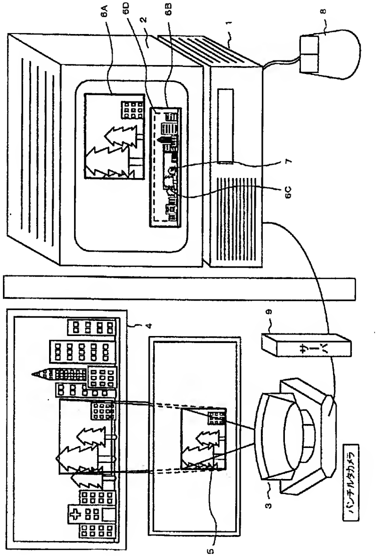
FIG. 21

3 ... PAN TILTER CAMERA

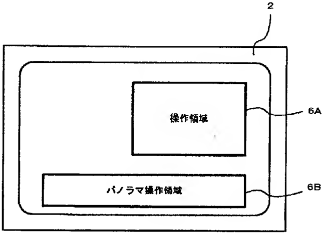
9 ... SERVER

【書類名】　　　図面

【図１】



【図２】



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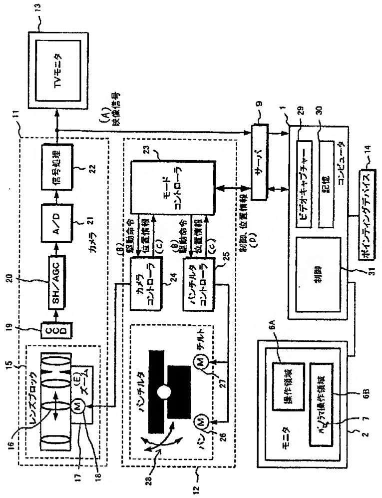
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信号処理
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SH／AGC
CCD
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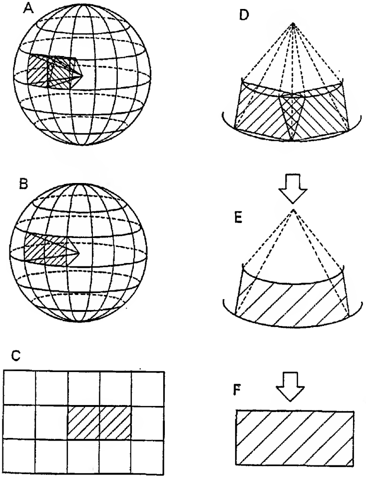
レンズブロック
(E) ズーム
M
モード コントローラ
(B) 駆動命令
位置情報 (C)
カメラ コントローラ
パンチルタ コントローラ
制御、位置情報 (D)
パンチルタ
パン
チルト
サーバ
ビデオキャプチャー
記憶
コンピュータ
制御
ポインティングデバイス
モニタ
操作領域
パノラマ操作領域

【図４】



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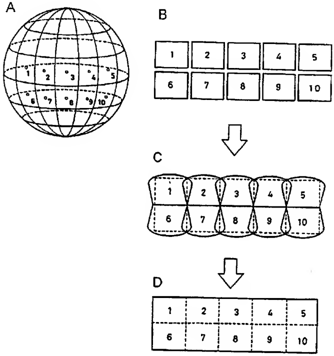
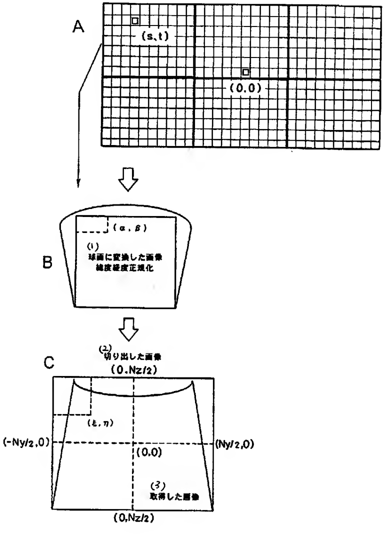
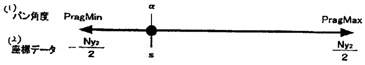


【図６】

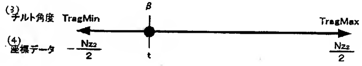

A
(s,t)
(0,0)
B
(α，β)
(1)
球面に変換した画像
緯度経度正規化
C
(2)
切り出した画像
(0,Nz/2)
(ξ，η)
(-Ny/2,0)
(Ny/2,0)
(0,0)
(3)
取得した画像
(0,Nz/2)

【図７】

A

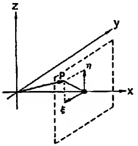

(1) パン角度
PragMin
α
PragMax
(2) 座標データ
$-\frac{Ny_2}{2}$
s
$\frac{Ny_2}{2}$

B

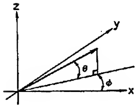

(3) チルト角度
TragMin
β
TragMax
(4) 座標データ
$-\frac{Nz_2}{2}$
t
$\frac{Nz_2}{2}$

【図８】

A

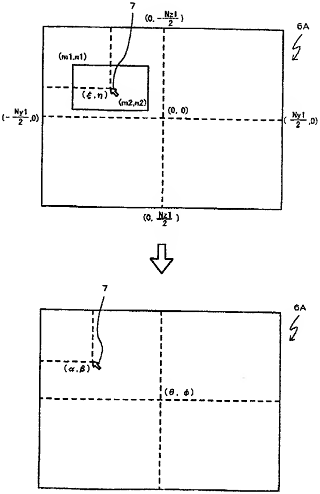


B



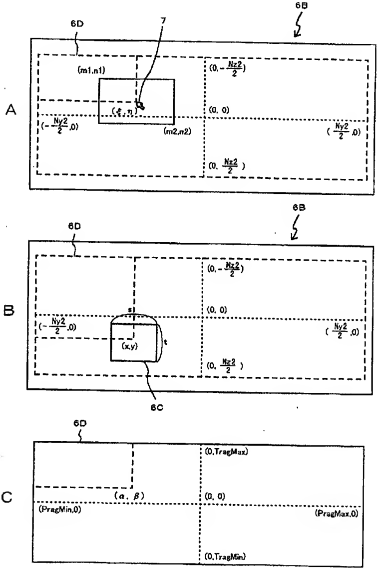
【図９】

A

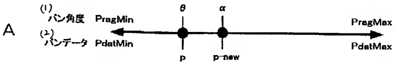

7
(0, $-\frac{Nz1}{2}$)
6A
(m1,n1)
(ξ, η)
(m2,n2)
(0, 0)
($-\frac{Ny1}{2}$,0)
($\frac{Ny1}{2}$,0)
(0, $\frac{Nz1}{2}$)
7
6A
(α, β)
(θ, ϕ)

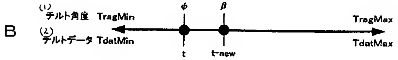
B

【図１０】

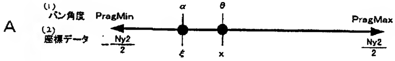

6B
6D
7
A
(m1,n1)
(ξ,η)
(m2,n2)
(0, 0)
B
(x,y)
s
t
6C
C
(0,TragMax)
(α, β)
(0, 0)
(PragMin,0)
(PragMax,0)
(0,TragMin)

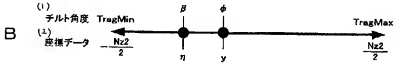
【図１１】


A
(1) パン角度 PragMin
(2) パンデータ PdatMin
θ
α
PragMax
PdatMax
p
p-new

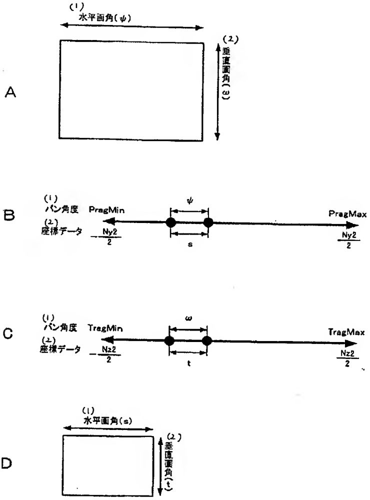

B
(1) チルト角度 TragMin
(2) チルトデータ TdatMin
φ
β
TragMax
TdatMax
t
t-new

【図１２】

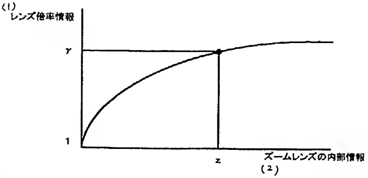

A
(1) パン角度 PragMin
(2) 座標データ -Ny2/2
α
θ
PragMax
Ny2/2
ξ
x


B
(1) チルト角度 TragMin
(2) 座標データ -Nz2/2
β
φ
TragMax
Nz2/2
η
y

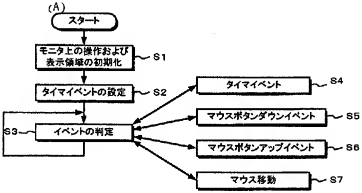
【図１３】


A
(1)
水平画角(ψ)
(2)
垂直画角(ω)
B
(1)
パン角度
PragMin
(2)
座標データ
$-\frac{Ny2}{2}$
ψ
s
PragMax
$\frac{Ny2}{2}$
C
(1)
パン角度
TragMin
(2)
座標データ
$-\frac{Nz2}{2}$
ω
t
TragMax
$\frac{Nz2}{2}$
D
(1)
水平画角(s)
(2)
垂直画角(t)

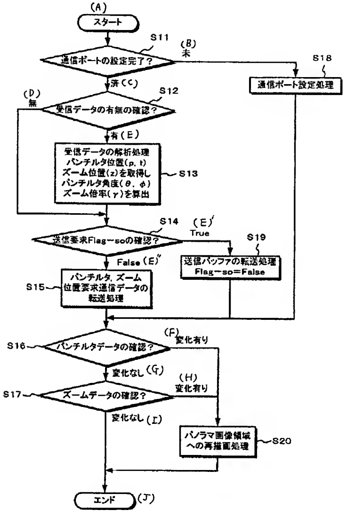
【図１４】


(1)
レンズ倍率情報
γ
1
z
ズームレンズの内部情報
(2)

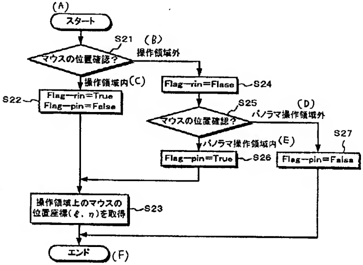
【図１５】


(A)
スタート
モニタ上の操作および表示領域の初期化
S1
タイマイベントの設定
S2
S3
イベントの判定
タイマイベント
S4
マウスボタンダウンイベント
S5
マウスボタンアップイベント
S6
マウス移動
S7

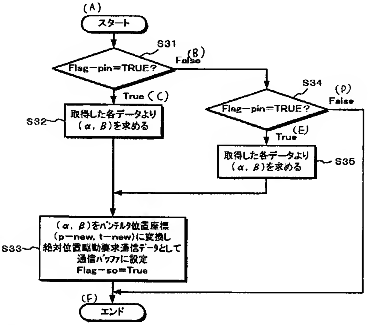
【図１６】


(A)
スタート
S11
(B)
未
通信ポートの設定完了？
S18
通信ポート設定処理
済(C)
(D)
無
S12
受信データの有無の確認？
有(E)
受信データの解析処理
パンチルタ位置(p, t)
ズーム位置(z)を取得し
パンチルタ角度(θ, φ)
ズーム倍率(γ)を算出
S13
S14
(E)'
True
S19
送信要求Flag−soの確認？
送信バッファの転送処理
Flag−so=False
False (E)"
パンチルタ, ズーム
位置要求通信データの
転送処理
S15
(F)
変化有り
S16
パンチルタデータの確認？
変化なし (G)
(H)
変化有り
S17
ズームデータの確認？
変化なし (I)
パノラマ画像領域
への再描画処理
S20
エンド
(J)

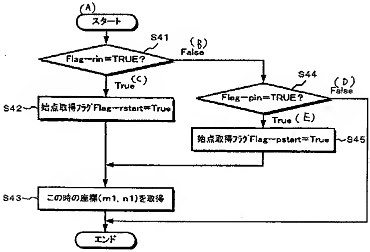
【図１７】


(A)
スタート
S21
(B)
マウスの位置確認？
操作領域外
操作領域内(C)
Flag—rin=Flase
S24
S22
Flag—rin=True
Flag—pin=False
S25
(D)
マウスの位置確認？
パノラマ操作領域外
S27
パノラマ操作領域内(E)
Flag—pin=True
S26
Flag—pin=False
操作領域上のマウスの
位置座標(ξ, η)を取得
S23
エンド
(F)

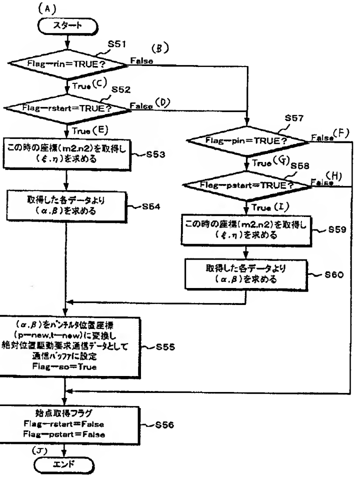
【図１８】


(A)
スタート
S31
(B)
False
Flag－pin＝TRUE？
True (C)
S32
取得した各データより
(α，β)を求める
S34
(D)
False
Flag－pin＝TRUE？
True (E)
取得した各データより
(α，β)を求める
S35
(α，β)をパンチルタ位置座標
(p－new，t－new)に変換し
絶対位置駆動要求通信データとして
通信バッファに設定
Flag－so＝True
S33
(F)
エンド

【図１９】


(A)
スタート
S41
(B)
False
Flag－rin＝TRUE？
True (C)
S42
始点取得フラグFlag－rstart＝True
S44
(D)
False
Flag－pin＝TRUE？
True (E)
始点取得フラグFlag－pstart＝True
S45
S43
この時の座標(m1，n1)を取得
エンド

【図２０】



(A)
スタート
S51
(B)
Flag—rin=TRUE?
False
True (C)
S52
Flag—rstart=TRUE?
False (D)
True (E)
この時の座標(m2,n2)を取得し (ξ,η)を求める
S53
取得した各データより (α,β)を求める
S54
S57
Flag—pin=TRUE?
False (F)
True (G)
S58
Flag—pstart=TRUE?
False (H)
True (I)
この時の座標(m2,n2)を取得し (ξ,η)を求める
S59
取得した各データより (α,β)を求める
S60
(α,β)をパンチルタ位置座標 (p—new,t—new)に変換し 絶対位置駆動要求通信データとして 通信バッファに設定 Flag—so=True
S55
始点取得フラグ Flag—rstart=False Flag—pstart=False
S56
(J)
エンド

【図２１】